

Biographical Sketch of Peter J.S. Smith

Peter Smith is currently Director of both the Molecular Physiology Program and the NIH:NCRR BioCurrents Research Center (BRC) as well as MBL Senior Scientist at MBL. He will also be the interim Director of the new Cellular Dynamics Program. Dr. Smith is a graduate of Aberdeen University, Scotland, where he completed his PhD in 1979 under the supervision of Dr. Peter Boyle. His thesis research was on the cardiovascular system of the octopus. He continued these studies, broadened to the Mollusca in general, through research visits to the Laboratoire Arago (France), the University of Rhode Island (US) and the Bermuda Biological Station, demonstrating the importance of volume regulation in cardiac output amongst several molluscan classes. In 1997 he coauthored the chapter on "Invertebrate Circulatory Systems" in the American Physiological Society's Handbook of Physiology. After three years at the University of Manchester, studying reticulospinal neuroanatomy with Prof. D.M. Guthrie, he moved to the University of Cambridge where, working initially with Dr. John Treherne, and then as a Leverhulme Research Fellow, he researched glial regeneration in the insect central nervous system, latterly demonstrating a role for progenitor cells in the CNS, as well as invasive and transforming hemocytes, in the restoration of the high resistance blood brain barrier. He was awarded an MA from Cambridge University in 1991. He left the position of Senior Scientific Officer (a government tenured research position) late in 1991, moving to the MBL and joining the NCRR Resource, directed by Lionel Jaffe. He became co-director in 1992, director in 1994, refunding the enterprise as the BioCurrents Research Center in 1996. The Center in its 3rd cycle of competitive review. Dr. Smith is author or co-author of 115 research papers, book chapters and reviews.

As Director of the BRC, Dr. Smith oversees a broad research program and staff of 10 full time positions. As a national resource of the NIH, the BRC specializes in the development and application of sensor technologies to characterize chemical profiles in the boundary layers adjacent to cell membranes. These layers present 'signatures', reflecting cellular transport events, metabolism and pathophysiology. The core technologies have focused on 'ultramicro' (< 10 μ m tip diameter) electrochemical electrodes of potentiometric, amperometric and enzyme assisted designs. These in-house developments produce a non-invasive analysis of these chemical signatures with high spatial and temporal fidelity and can be coupled to conventional approaches for electrophysiology and confocal imaging. An emphasis on layering techniques has dominated this funding period (2004 – 2009). This has been, in part, a response to the high impact the resource is having in the study of single cell metabolism. Hence the BRC group has also developed low light imaging techniques for monitoring both population and single cell ATP dynamics. Under development are technique refinements to follow single channel events non-invasively through their diffusion profiles (Messerli et al. 2007: Biophysical J. 92(7); L52-54) as well as monitoring drug transport through cancer related ABC transporters and the stoichiometric analysis of non-electrogenic transporters, such as the K⁺/H⁺ ATPases. The BRC, as a collaborative group, continues to further advance the repertoire of sensor types, recently developing and/or applying phosphate, sodium and chloride sensors, with an additional focus on developing feed back systems for remote guidance and sub-micron positional control. In biological and biomedical applications the in-house and collaborative outreach overseen by Dr Smith is diverse. Highlights can be found at www.biocurrents.org.

Several thematic collaborative areas have been developed over the years: For example, diabetes, degenerative diseases, reproductive physiology, metabolism, toxicology, development and regeneration. Although our focus is by necessity on NIH funded investigators the scope has been broadened to include research on biofilms (DOD), calcification events in corals (NSF) and plant transport physiology (NSF).

Over the next few years Dr. Smith's research interests will continue to be reflected in the emphasis given to the activities of the BRC. Several new initiatives are on the horizon. One particularly fascinating development is to seize control of the otherwise individualistic behavior of the single cell by using a technique known as dielectrophoresis. This allows the controlled placement of single cells or the aggregation of cells into pseudo-tissues/tumors (Pethig, R., et al, 2008; *IET Nanobiotechnology* in press). These can be co-localized with nanosensors for studying chemical dynamics in the intercellular space, or preloaded with reporter molecules for the study of cell-cell communication and signaling mechanisms. In the area of cell physiology the group is expanding its in-house interests into the mechanism of action for anti-apoptotic proteins in cardiac muscle, a development of a neuronal study with collaborator Liz Jonas (Yale), as well as a new thrust to understand, measure, and characterize, the performance of plasma membrane electron transport in cell cycling and oncology. The aim here is to place this alternative redox cycling method into the broader context of cell metabolism, glycolysis and the Krebs cycle.

At the institutional level Dr. Smith anticipates a continued, and expanding collaborative base within both the resident and visiting programs. There are also plans for expanded outreach to Brown University through the initiated joint ventures in nano engineering and biology (Dr Smith is a member of the Brown University Institute for Molecular & Nanoscale Innovation) and clinical/science translation (Dr Smith is participating in the planning for the new Clinical Translational Science Institute).